Development of Algorithms for Small Port Throughput: Ingress/Egress

JLOTS Symposium

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Presented by: Ms. Debbie Green, USACE ERDC-WES

Mr. Greg Green, USACE ERDC-WES

Background

The work described here will be performed under the "Rapid Port Enhancement for the Theater Support Vessel" STO by the ERDC Geotechnical & Structures Lab and the ERDC Coastal & Hydraulics Lab.

Objectives

- To identify a comprehensive set of environmental and physical factors pertinent to both ingress and egress throughput rates analysis through small ports.
- Develop algorithms and possible relationships based on these factors that can be used in throughput and force projection models to produce accurate results.

INGRES
S

What environmental factors should be considered?

- Weather - Wind, temperature, precipitation
- Surface conditions – waves, obstacles, buoys, markers
- Terrain (underwater) - bathymetry, currents, offshore & nearshore sandbars, shoreline type, basin size/shape
- Temporal - seasons, tides

What physical factors should be considered?

- Work rates - offload rates, mooring times, down times
- Structural – port & pier characteristics (i.e. berths, lanes, pier length & width, weight capacity), jettys & breakwaters, submerged obstructions
- Other – all potential impediments/bottlenecks

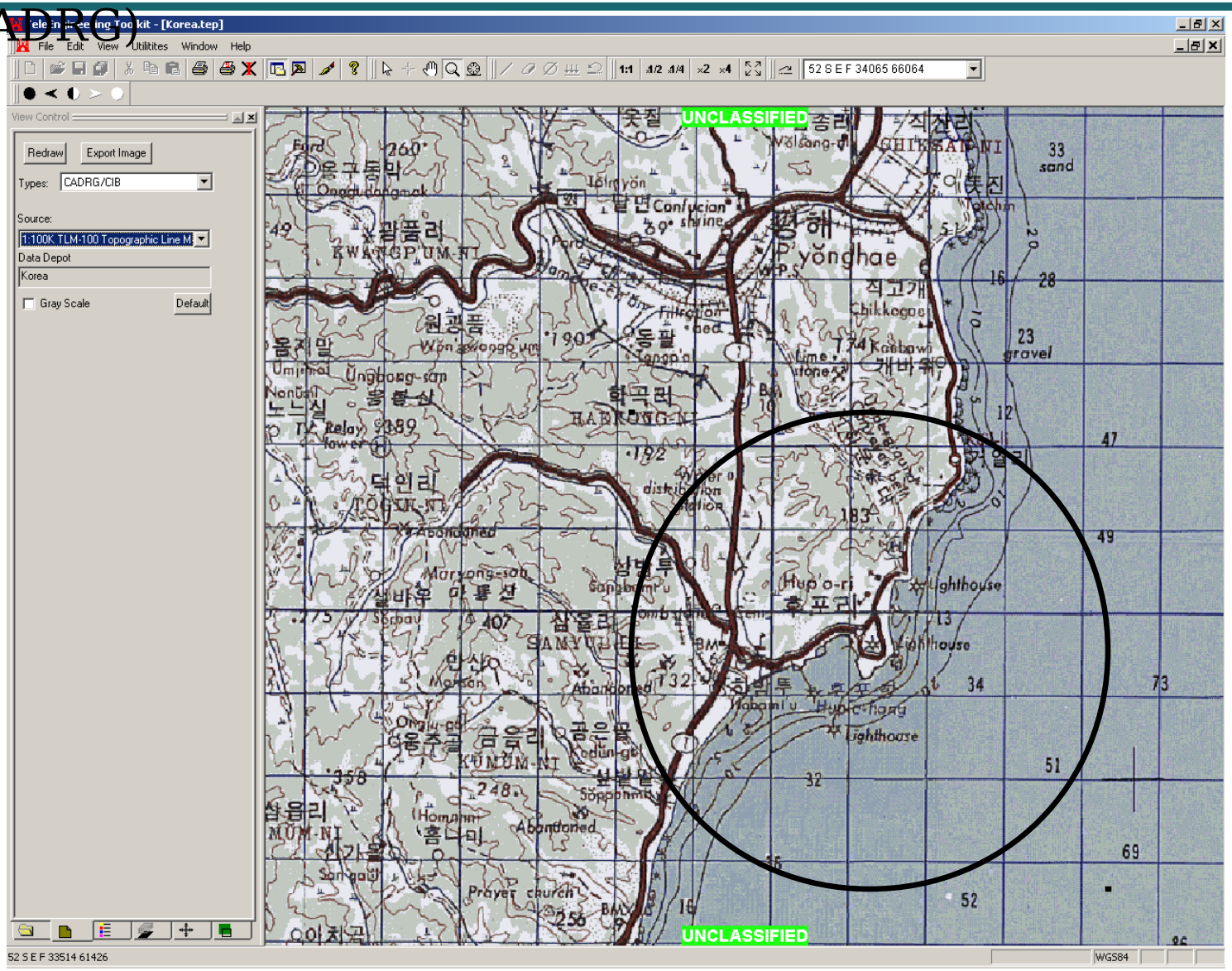
What sources can be used to develop these algorithms?

- Theoretical models
- Empirical models
- Subject Matter Experts (Field Manuals, Technical Reports, Journal Articles, References)
- Lab tests
- LOE results

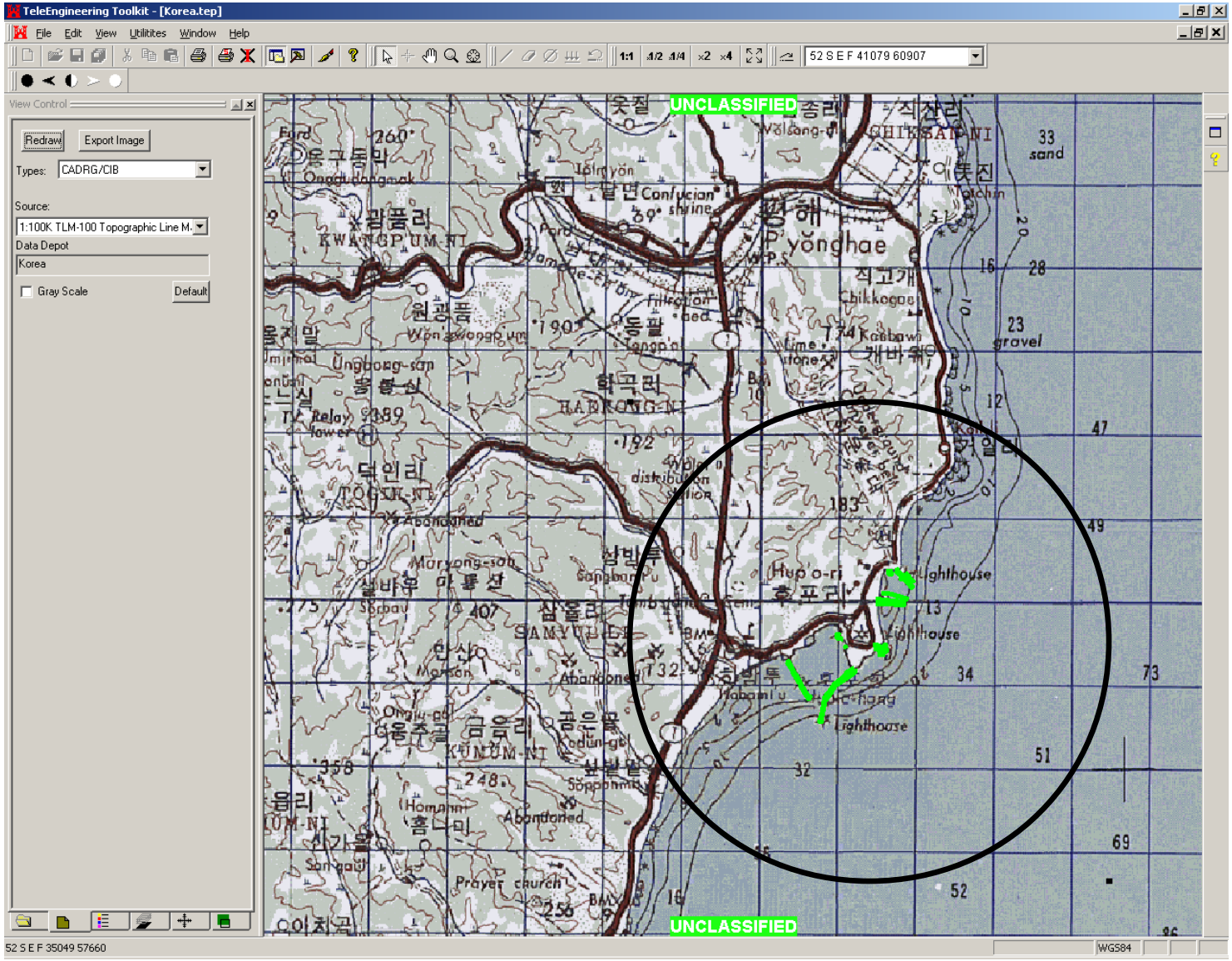
What potential sources can be used to feed these algorithms?

- National Imagery and Mapping Agency (NIMA) products such as Interim Terrain Data (ITD), Digital Nautical Chart (DNC)
- Exercise Results
- Master Environmental Library (MEL)
- SHOALS Data
- Inferencing Techiques

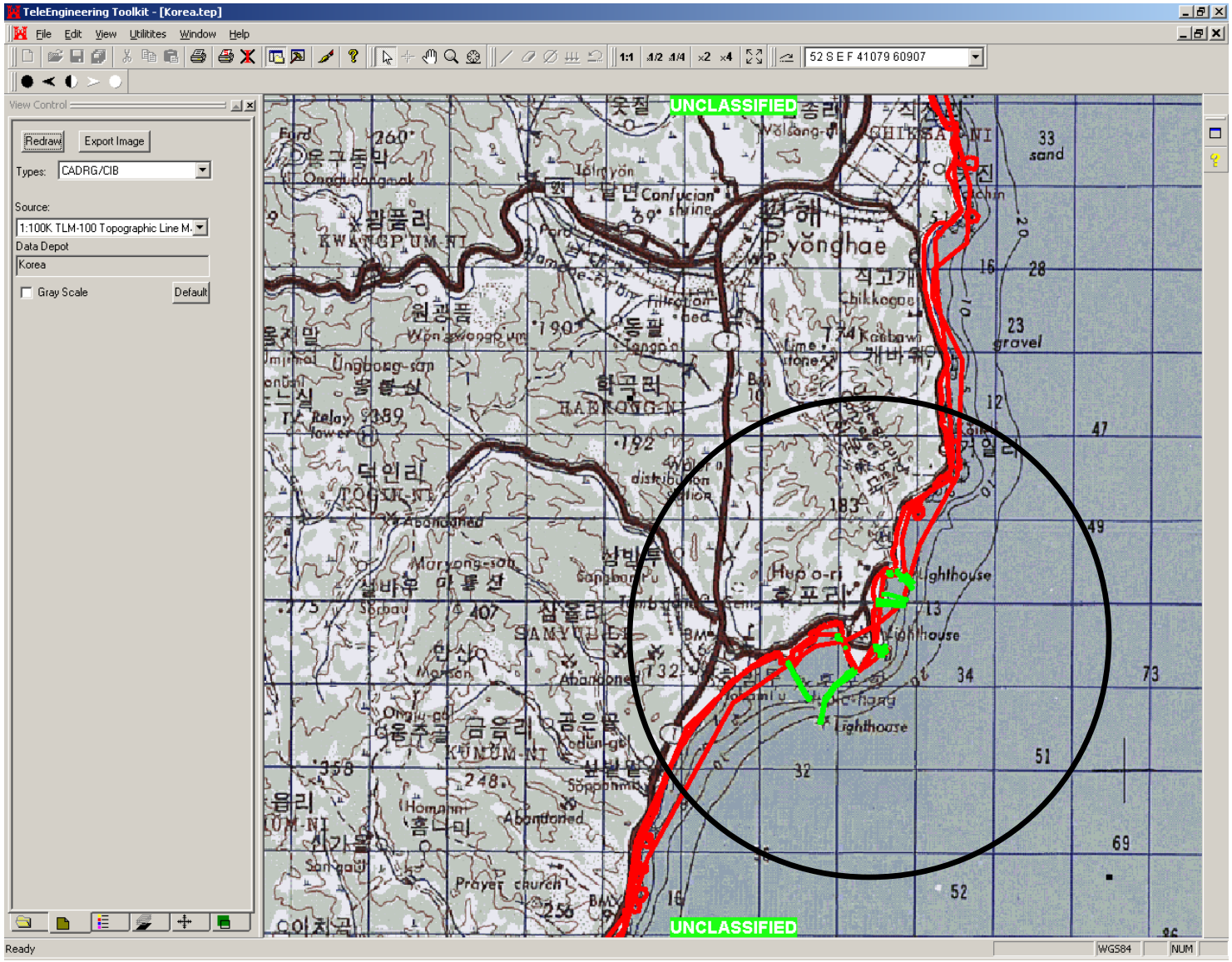
Port at Hup'o-Hang, South Korea and surrounding area (CADRG)



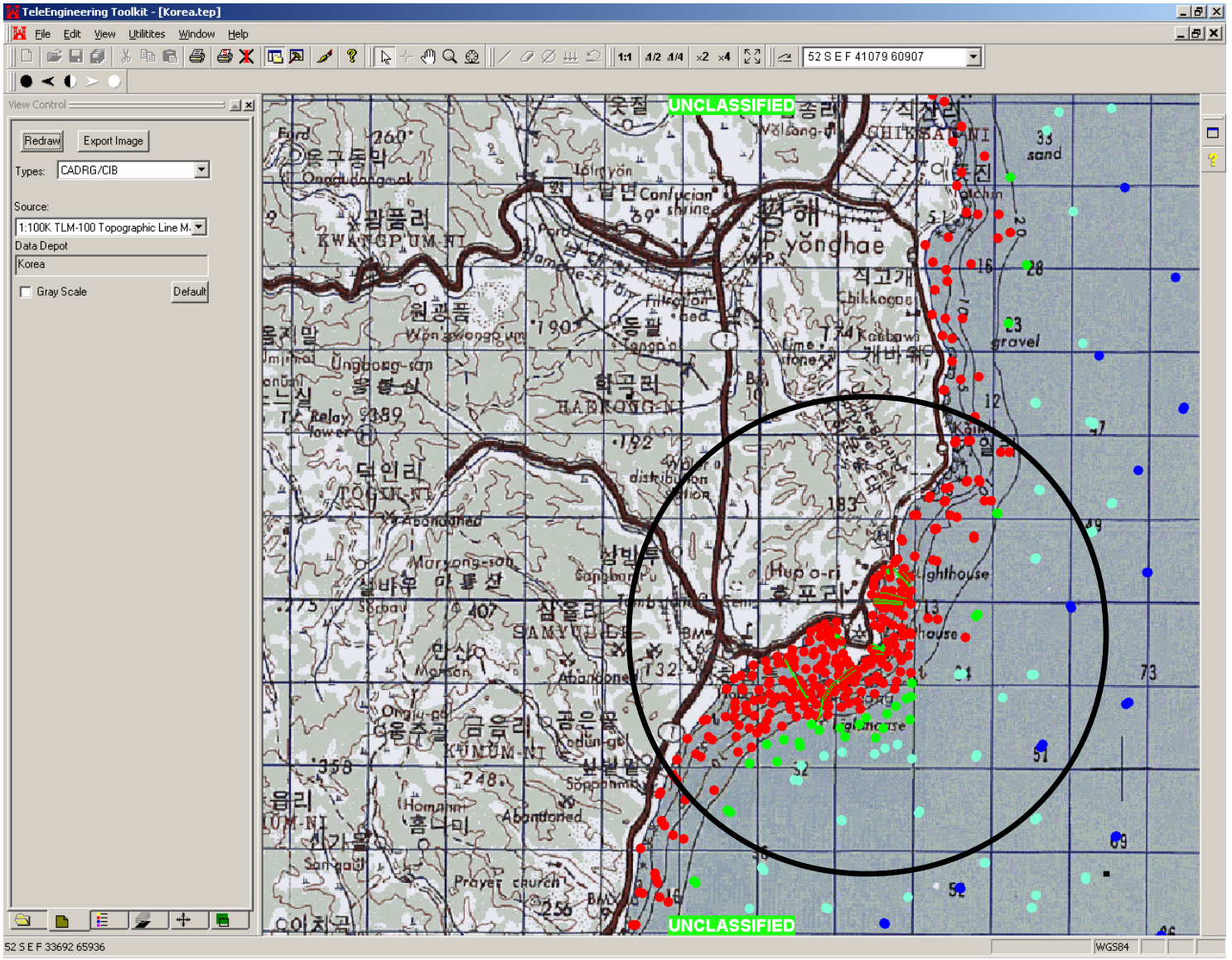
Port Facilities (DNC Overlay)



Shoreline Location and Type (DNC Overlay)



Hydrography Depth (Soundings) (DNC Overlay)



What are some examples of relationships that can be developed?

Vessel Draft vs. Limiting Water Depth

Vessel Mooring vs. Port Facilities

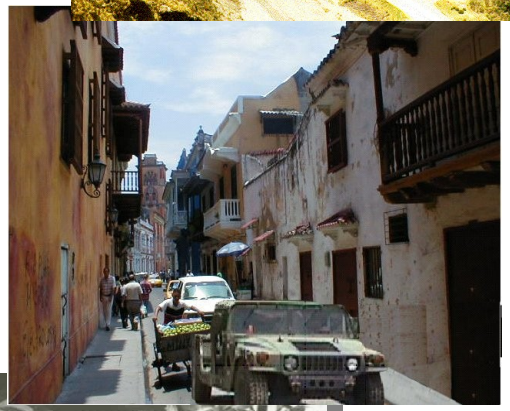
Stevedore Work Rates vs. Climate

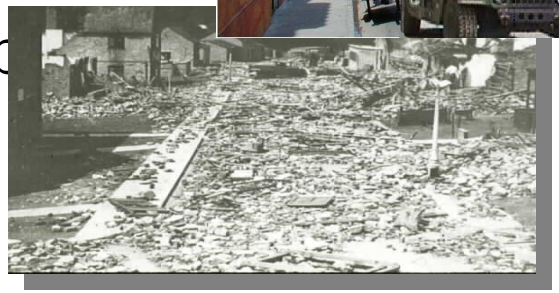
Cargo Type vs. Cargo Capabilities at Port

Cargo Weight vs. Weight Bearing Capacity at Pier

EGRESS

What environmental factors should the algorithms consider?



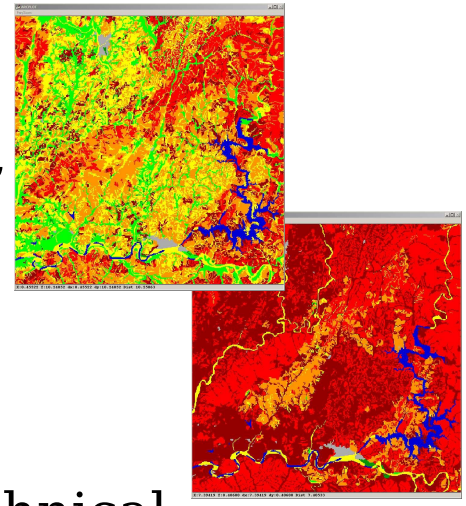


- Weather - precipitation, visibility, temperature, evaporation rates
- Terrain (offroad) - soils, vegetation, surface roughness, obstacles (ditches, levees, embankments, drainage features), elevation
- Terrain (onroad) - road type, road conditions, CBR, obstacles (rub craters), elevation
- Other - civilian traffic, choke points, bottlenecks

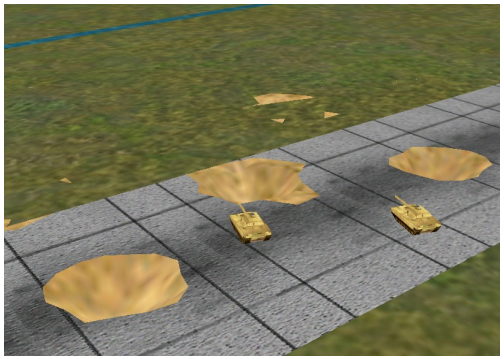
What physical factors should the algorithms consider?

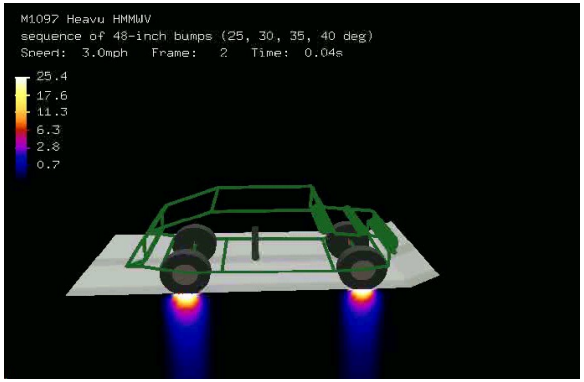
- Work rates - military engineers, civilian
- Equipment availability
- Structures - piers, bridges, tunnels (weight capacities, damage)

What sources can be used to develop these algorithms?

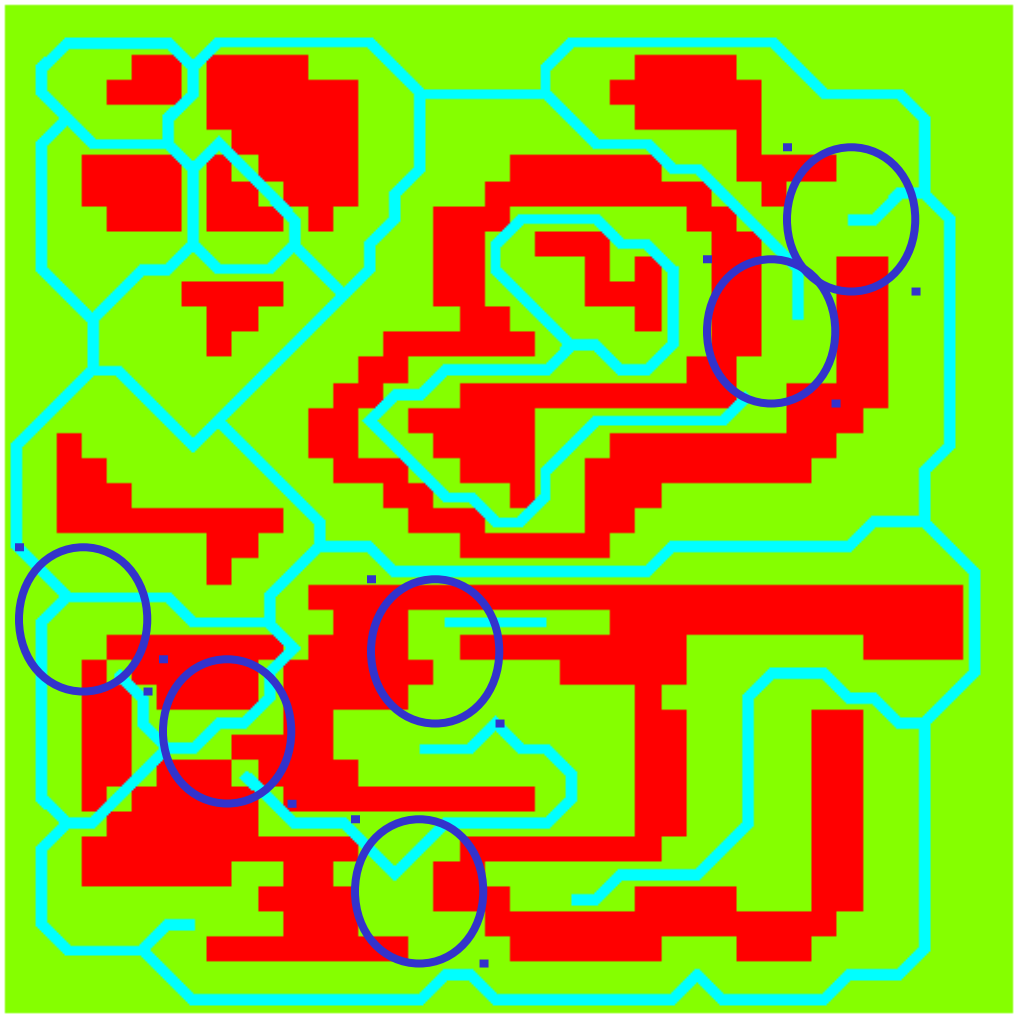


- Theoretical models (VehDyn, DADS, IBARS, PCASE)
- Empirical models (NRMM, CMM, SMSP)
- Field Test Results (ERDC-WES, APG)
- Subject Matter Experts (Field Manuals, Technical Reports, Journal Articles, References)





Example of Classical Thinning



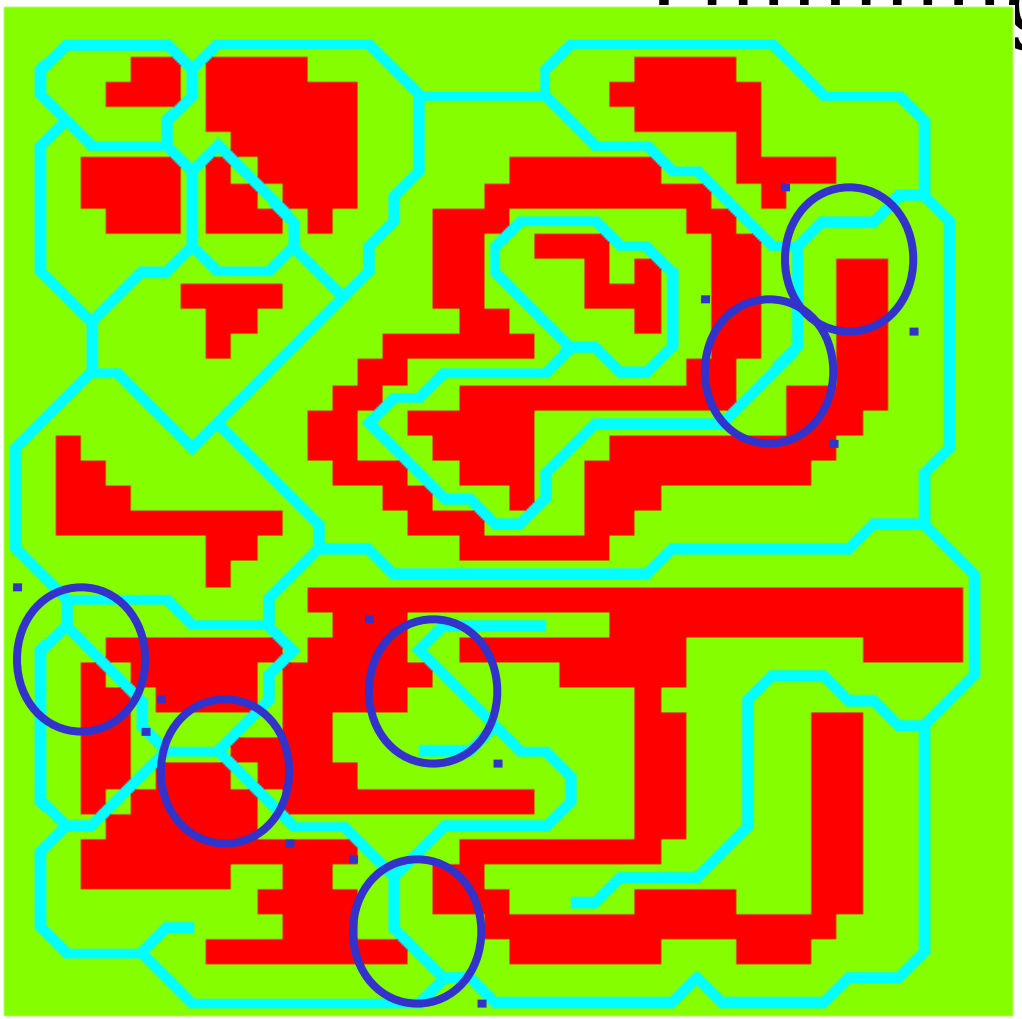
GO

NOGO

Result of Classic Thinning

Problem Areas

Example of Modified Classical Thinning



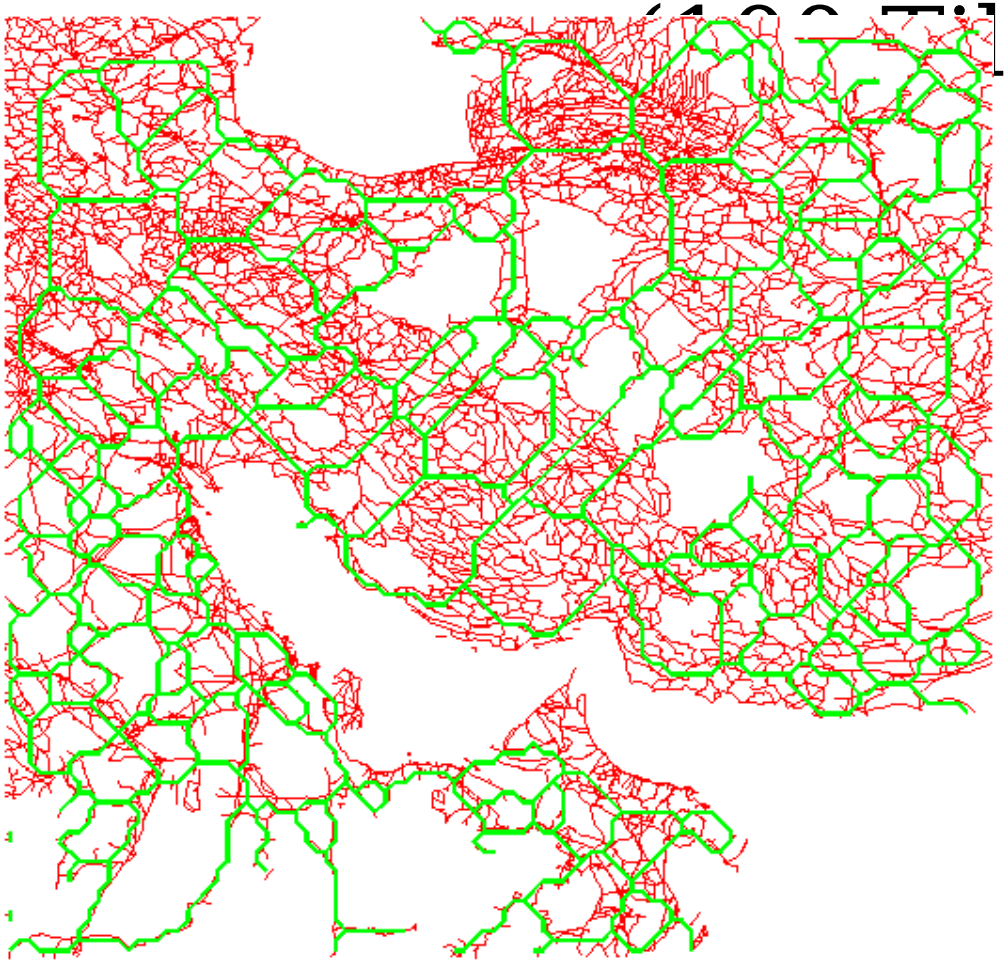
GO

NOGO

Result of Classic Thinning

Fixed Problem Areas

Resultant Network: Big SWA (100 Tiles)



Input Roads

Aggregated Represent

EDGE STATISTICS

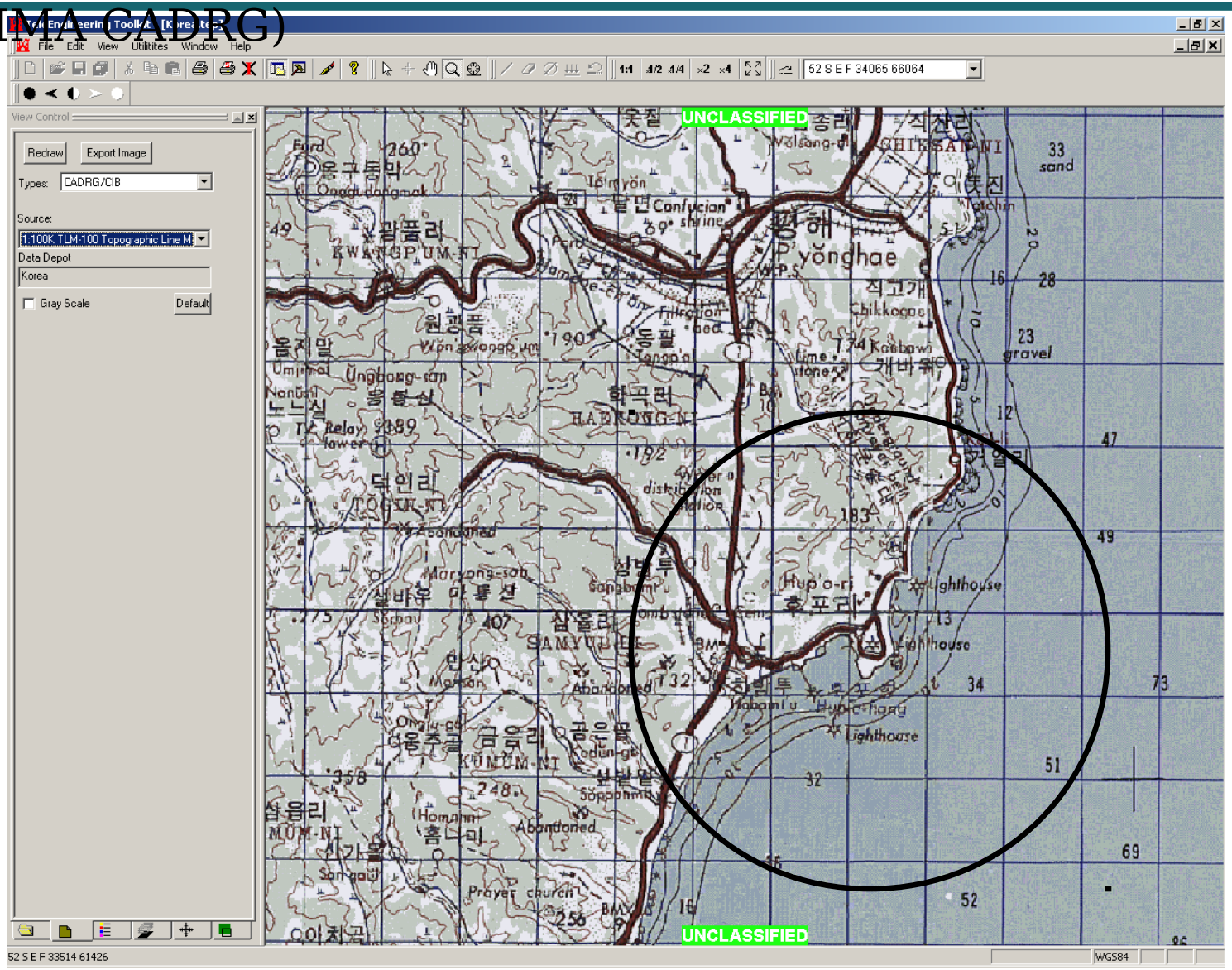
Original Input: 30,394

400 Tiles: 401

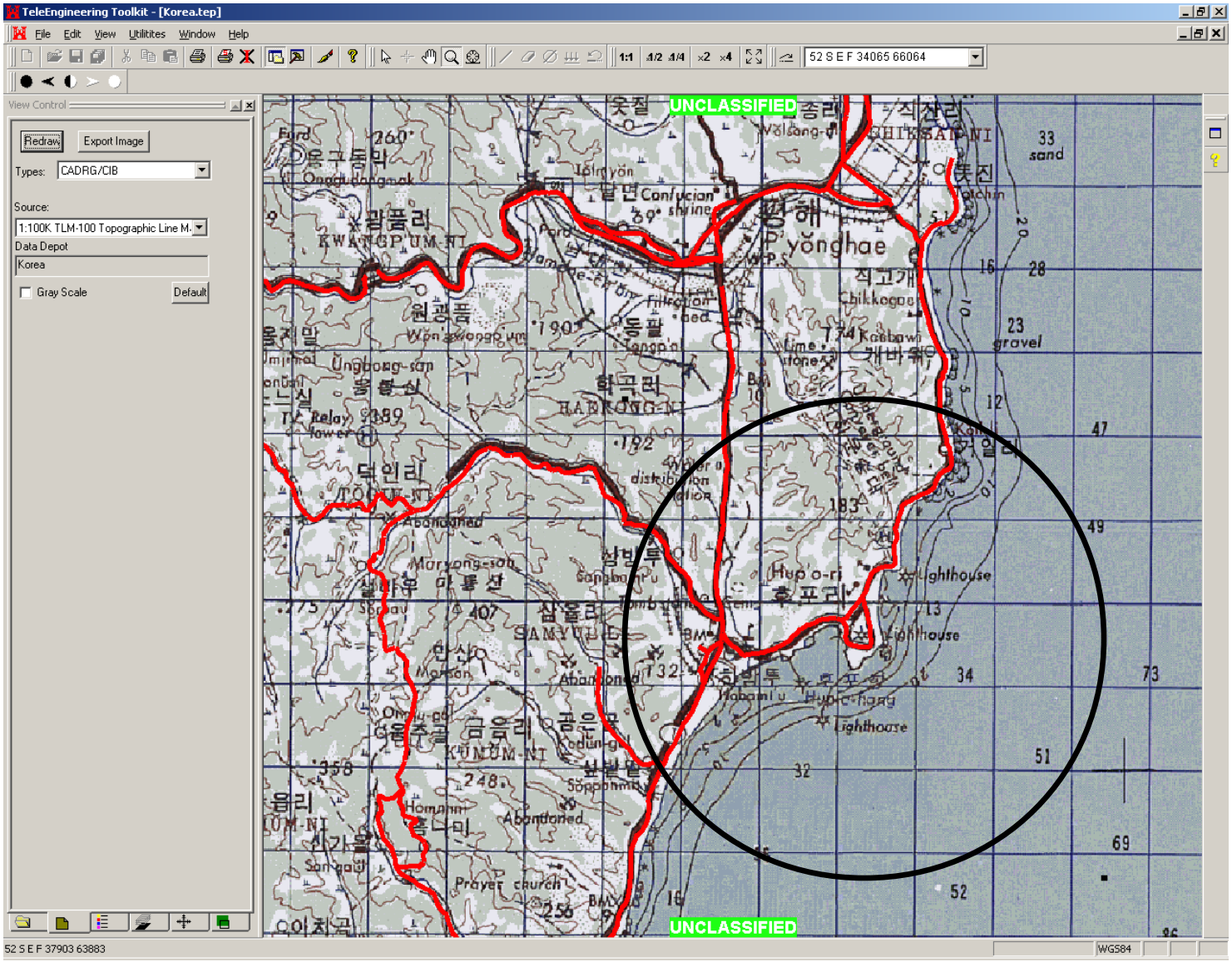
What sources can be used for data needed by algorithms?

- National Imagery and Mapping Agency (NIMA) products such as Interim Terrain Data (ITD)
- USGS Data
- Topographic Maps
- Environmental Data Model (EDM)
- Aerial Photographs (SPOT and LANSAT Imagery)
- Inferencing

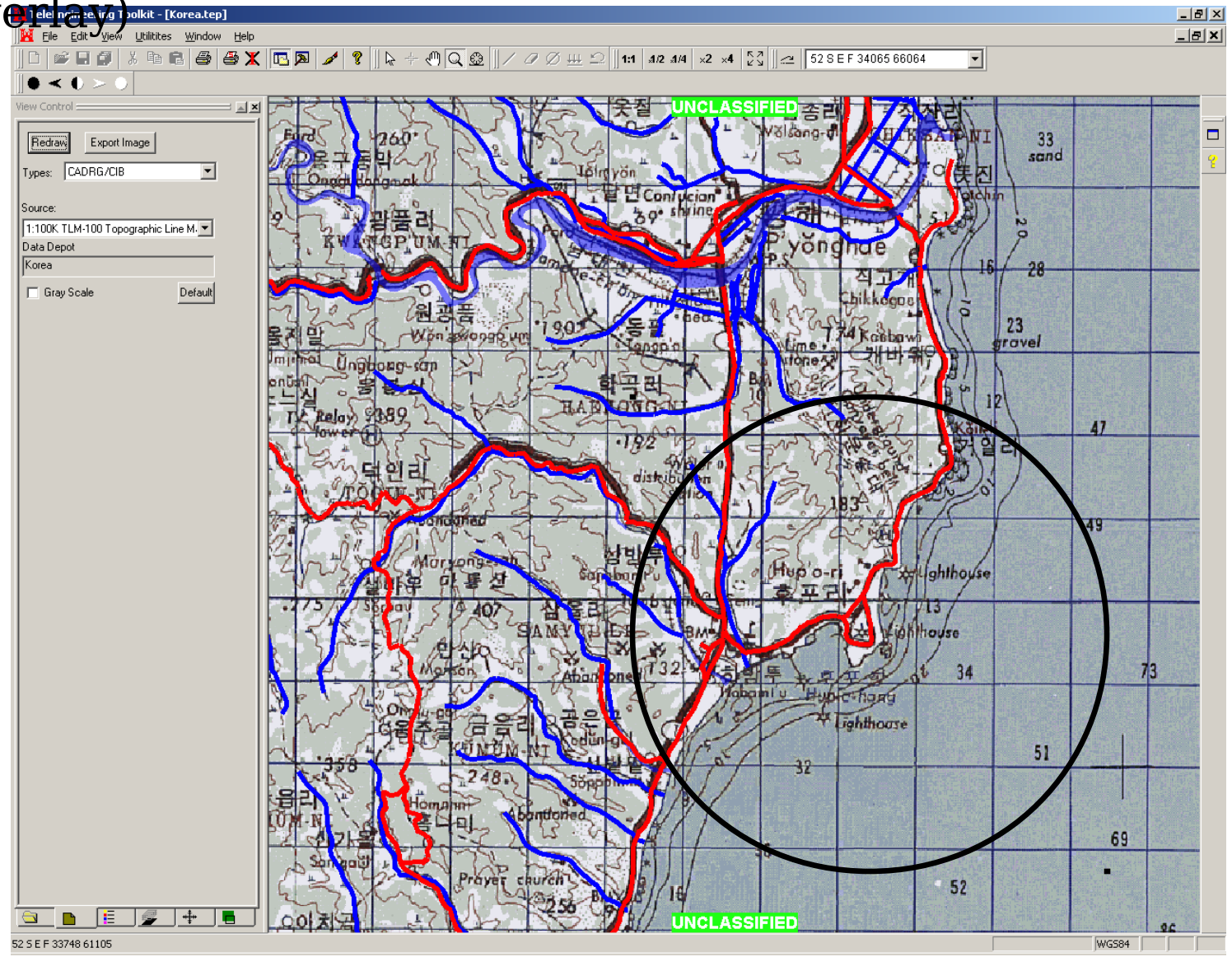
Port at Hup'o-Hang, South Korea and surrounding area (NIMA CADRG)



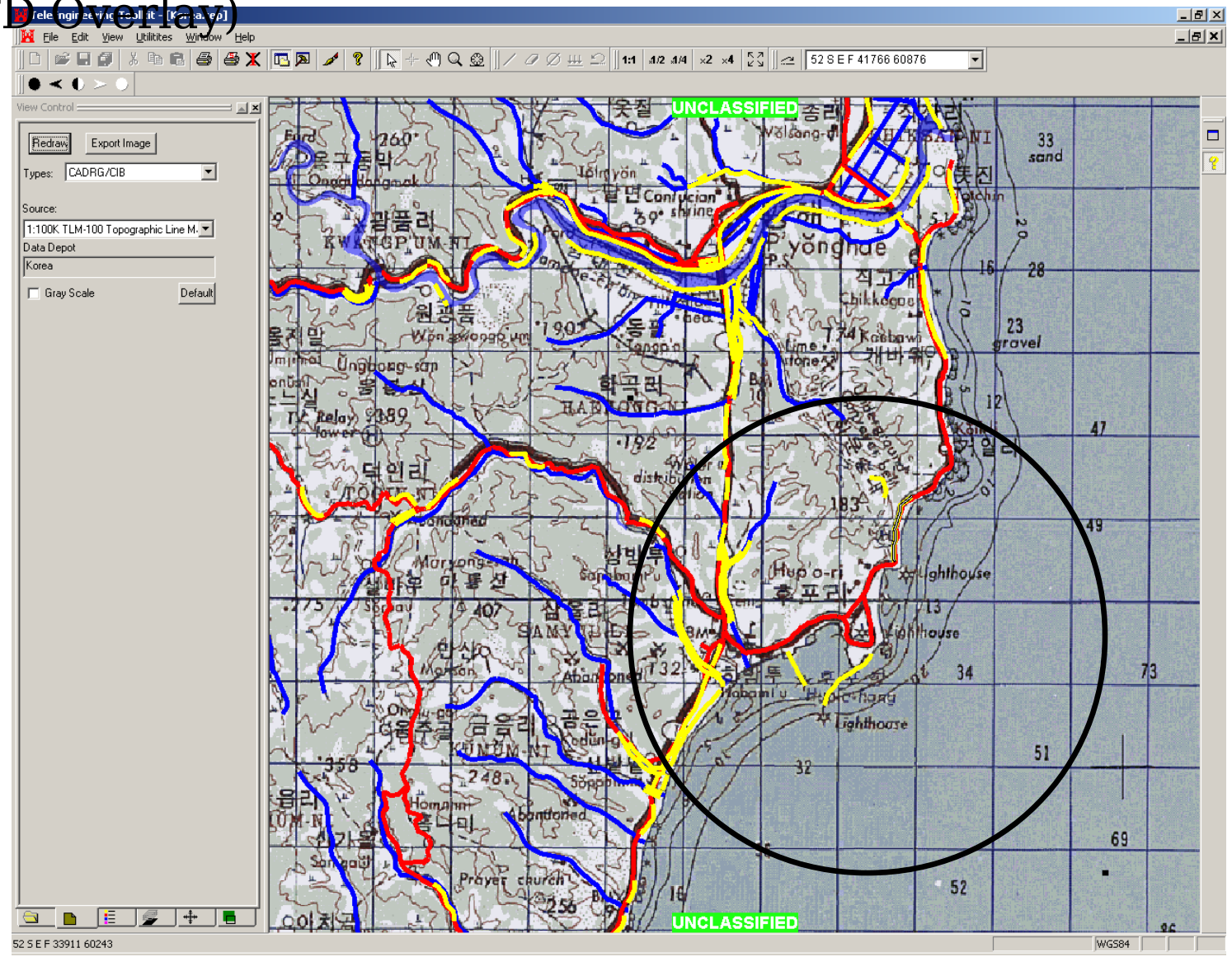
Road Network (ITD Overlay)



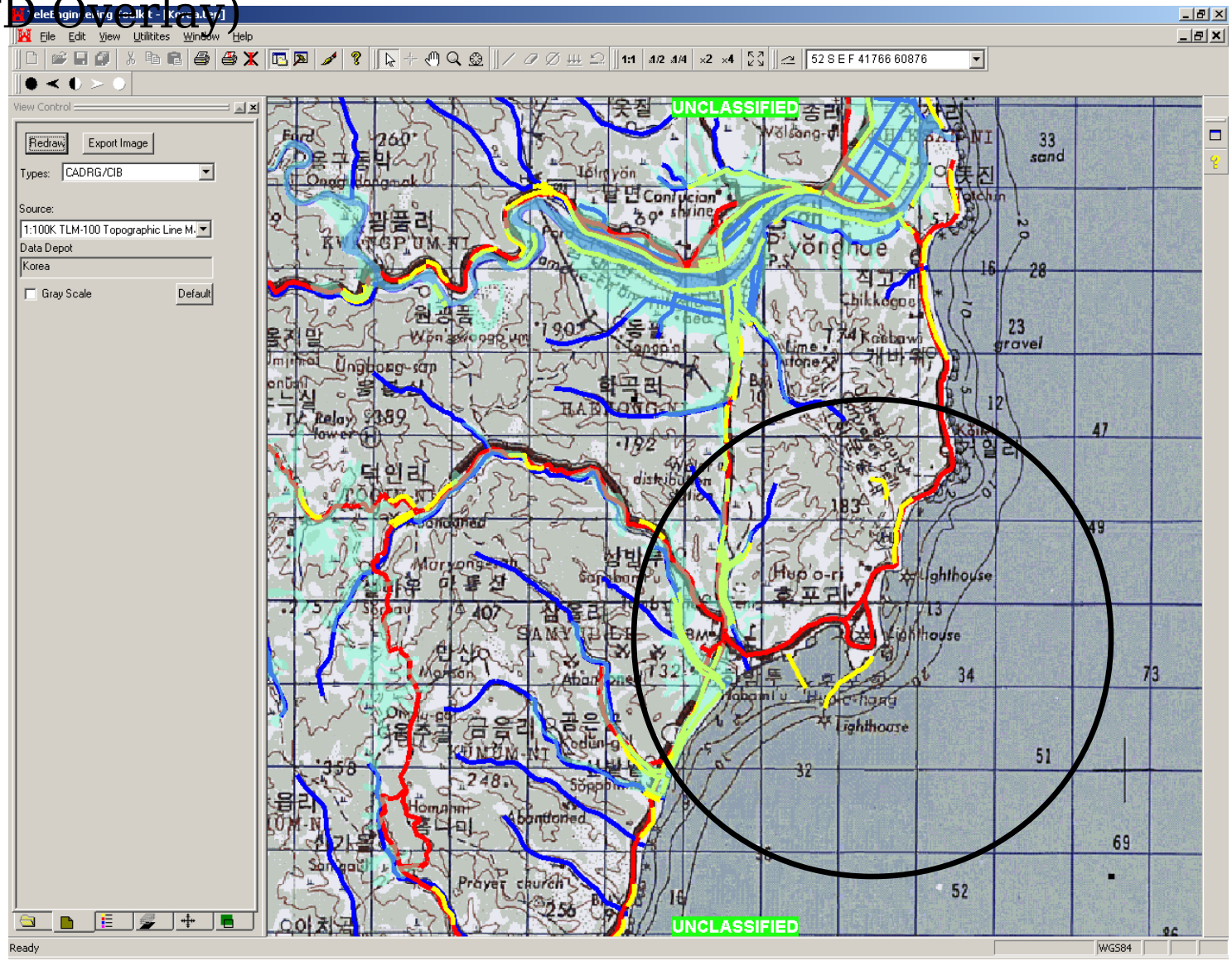
Drainage System (Rivers, Canals) (ITD Overlay)



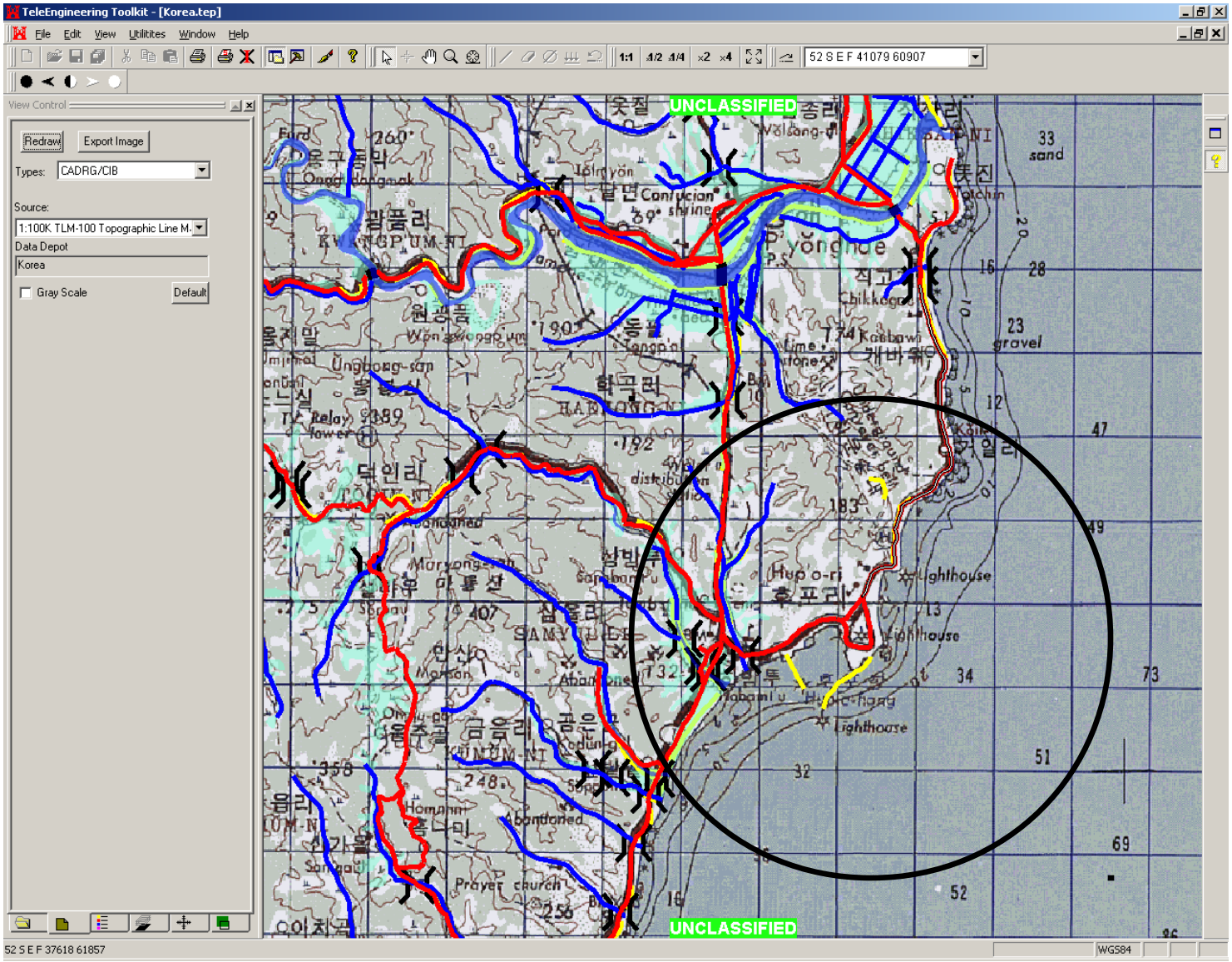
Obstacles (Ditches, Embankments, Cuts, Levees, Walls) (ITD Overlay)



Vegetation (Inundated land, rice fields, marshes, swamps) (ITD Overlay)



Bridges & Tunnels (ITD Overlay)



What are some examples of relationships that can be developed?

Vehicle Speed vs Soil Strength (Seas

Vehicle Ride vs Surface Roughness

Vehicle Speed vs Road Radius of Curvature

Vehicle Shock vs. Obstacle Geometry

Vehicle Speed vs. Surface Type (SuperHighway, Primary, Secondary, Trails, Off-road)

Vehicle Speed vs. Visibility (Seasc

Vehicle Pass Rate vs. Bridge Type

QUESTIONS?